# ENGINEERING NEWS

Tribune Building, New York City.

GEO. H. FROST, PROPRIETOR.

SATURDAY, JUNE 11, 1881.


THE Panama Railroad has been bought by the Canal Company on the basis of 250 per share, making the amount, with the cash assets retained by the Railroad Company, equal to about twenty millions of dollars, or, to the shareholders, 295 per share for their stock.

A MEETING of the Engineers and Surveyors of Pennsylvania is to be held at Harrisburg, Pa., some time in October. The proceedings of the last convention, held Oct. 27, at that city, have been published, and form a pamphlet of fifty-five pages, which cannot fail to be of interest to surveyors.

We publish this week an account, with illustrations, of the great Chaudière Bridge at Ottawa, Canada, a visit to which is on the programme of the Convention for the 16th, when Mr. Peterson, the Engineer, will also be present, and it is the season when the "Big Kettle" is in most active ebullition.

THE *Revue Générale des Chemins de Fer* has issued with its last number a very fine mounted railroad map of France on the scale of $\frac{1}{1000000}$. Single and double gauges, and trunk and secondary lines, etc., are clearly indicated, without giving that "gridironed" appearance which similar maps generally present.

AT the meeting, of May 17, of the Western Society of Engineers, A. W. Wright read a paper on "The Best Pavement for Horse Railroad Tracks," and endeavored to show that "cobble stone" was the best. At the same meeting, S. S. Greeley, who is an authority on the subject, read a paper on "Pavements for City Streets," in which he advocates an improved wood pavement which he describes in his paper. These papers are published in full in the *American Engineer* (Chicago) for June, which also gives two pages of details of the Sabula Bridge, on the Chicago, Milwaukee & St. Paul Railroad.

THE Russian engineers are renewing the project of a canal between the Black and Caspian seas, an idea which we are told was formed in the times of "hoar antiquity." Plans for making a connection between the Volga and the Don were drawn up in the reign of Sultan Selim, and are preserved yet—somewhere. The great mass of water in the River Terek attracted the attention of M. Daniloff, the Russian engineer, owing to the great height of the river, nearly 500 feet above the level of the Black Sea. The volume of water is from 175 to 554 cubic meters per second. Four branches will complete the junction of the Azor and the Caspian, and the Don and the Volga.

THE French civil and military engineers are not agreed upon a very dangerous matter—dynamite. The military are in favor of taking the thing cool—in a frozen state, and a Captain Lebon gives his method for employing dynamite in a frozen condition—except in mining holes. But this very exception is the general rule for the use of dynamite. The inequalities of the mining hole would be sure to cause an explosion, so that the thawing of the article cannot prevent any great danger. The liability to freezing is far greater where the nitroglycerine is of small percentage. Persons who do not require the explosive on a large scale, are advised to have it placed in a dung-heap, so as to keep it from freezing.

ONE of the most useful appliances that has recently been offered to contractors, is Carson's Excavator, for use in excavating for sewers, canals, water pipes, etc. Mr. Carson is an engineer in the service of the City of Boston, but the right to use his machinery has been purchased by that city, after having given it a fair trial. We personally saw it at work on a section of the improved sewerage, and, although an experimental, and necessarily an imperfect structure, yet the results were very satisfactory as compared with the ordinary method. In a comparison of this machinery with a steam derrick in first-rate condition and efficiently served, the other conditions being almost precisely the same, the earth excavated by the steam derrick cost, per yard, $25\frac{4}{10}$ cents; that excavated by the Carson Excavator cost $11\frac{15}{100}$ cents, the latter being the experimental one above referred to.

THE following have been elected officers of the Florida Everglades drainage scheme: President, William S. Stokley, ex-Mayor of Philadelphia; Vice-President, Colonel J. J. Dunne; Treasurer, Hamilton Disston; Secretary, James A. Kreamer; directors, W. S. Stokley, Hamilton Disston, Samuel H. Gray, W. C. Parsons, W. H. Wright, W. H. Drake, J. Coryell, J. J. Dunne and A. K. P. Safford. The capital of the company is $10,000,000, or 1,000,000 shares at $10 per share. The policy of the company will be to settle colonists on their lands as soon as practicable, and for that purpose emigration agencies will be established in England and on the Continent of Europe and on the Island of Sicily. A member of the syndicate will sail for Europe on June 25 for the purpose of organizing a colonization scheme which will result in bringing to America a large number of immigrants who will be taken by a chartered steamer direct to Jacksonville, Florida.

The whole scheme of draining the Everglades promises the greatest success. Letters from all parts of the world are received daily in reference to it, and a number of capitalists are negotiating for an interest in the shares.

THE Civil Engineers' Excavation and Embankment Tables, for the rapid and accurate finding, directly from cross-section notes, of the cubic contents of railroad excavations and embankments, by Clarence Pullen and Chas. C. Chandler, Civil Engineers, and published by the J. M. W. Jones Stationery and Printing Company of Chicago, is a neat and compact book of seventy pages, of $6\frac{3}{4}$ by $9\frac{1}{2}$ in., printed in large type, and well-bound in boards. The tables are calculated on the basis of the Prismoidal Formula, and the method was first introduced to the notice of civil engineers by G. B. Lake, C. E., in Van Nostrand's Engineering Magazine. The greater part of the tables, comprising the present work, were calculated by the Engineer Corps of the A. T. and S. Fe R. R., and furnished to the authors by Chief Engineer Robinson, of that road. To these tables have been added a sufficient number of others to apply to all the usual widths of roadbeds, and every practical check and test has been employed to insure perfect accuracy. The contents of the book are: The Introduction, Construction, Explanation and Application of the Tables, Prismoidal Correction Table, Level Prismoid Tables and the First Correction for Base, 12, 14, 16, 18 and 20 feet, with slopes $\frac{1}{4}$, $\frac{1}{2}$, 1 and $1\frac{1}{2}$ to 1; also Table of Correction for Elevation on Curves.

## CONVENTION NOTES.

The following additional names were registered at the rooms of the Society up to noon of the 9th: To Niagara Falls: J. H. Armington, Chief Engineer Brooklyn Gas Works; A. B. Abbott, Assistant Engineer East River Bridge; Jas. D. Burr, of Topeka, Kan., and Mrs. Burr; A. P. Boller, Chief Engineer Manhattan Elevated R. R., New York City; J. G. Bodemer, C. E., Berlin, Germany; Martin Coryell and Mrs. Coryell, Lambertville, N. J.; Theodore Cooper, C. E., New York City; Amory Coffin, Phœnixville, Pa.; J. Dahll, C. E., Christiana, Norway; Jos. P. Davis, Vice-President Metropolitan Telephone Co., New York City; C. G. Force, C. E., Cleveland, O.; Geo. H. Frost, ENGINEERING NEWS, and Mrs. Frost, New York City; Rudolph Hering, Assistant City Engineer, Philadelphia; Mrs. Hering, Miss Gregory, Carl Hering, of Philadelphia; A. B. Hill, Assistant City Engineer, New Haven, Conn.; S. Haslitt, C. E., New York City; S. S. Haight, C. E., New York City; Chas. Kellogg, Bridge Engineer, Athens, Pa.; S. F. Lewis, C. E., New Orleans, La.; C. S. Maurice, Bridge Engineer, Athens, Pa.; Niles Meriweather, C. E., Memphis, Tenn.; Jno. McLeod and Mrs. McLeod, Louisville, Ky.; H. Manley, C. E., Boston, Mass.; Geo. H. Norman, C. E., Boston, Mass.; J. N. Stanley, Brooklyn; S. E. Tinkham, Secretary Boston Society of Civil Engineers, J. W. Doane, President Boston Society of Civil Engineers; E. B. Van Winkle, Engineer Topographical Department, N. Y. City; J. G. Van Horne and Miss Van Horne, Jersey City; Wm. H. Wiley, of Messrs. Jno. Wiley & Sons, Publishers, N. Y. City, and Mrs. Wiley; C. D. Ward, C.E., Jersey City; Col. A. F. Wrotnowski, Engineer Louisiana Levee Commission, New Orleans, La. To Montreal: W. S. Barbour, City Engineer Cambridge, Mass.; H. Bissell, Master of Maintenance of Way Eastern R. R., Boston, Mass.; Capt. J. B. Cotton, City Surveyor Newport, R. I.; Francis Collingwood, Assist. Engineer East River Bridge; Lieut. Com. H. H. Gorringe, U. S. N.; Prof. J. E. Hilgard, U. S. Coast Survey, Washington, D. C.; G. P. Low, C. E., Boston, Mass; F. O. Norton, New York City; S. C. Pierson, W. Meriden, Conn.; J. J. R. Croes, New York City.

The following additional papers to be read have been reported to the Secretary: Sewerage Systems, by R. Hering, Philadelphia, and Report on Tests of Cements, by J. D. Whittemore, Chairman of the Committee on that subject.

THE popularity of the very attractive programme of the American Society for the coming convention is very clearly demonstrated by the long list of distinguished names that we have already published and to which more will yet be added. From Boston to New Orleans, from St. Louis to Baltimore, the engineering profession of this great continent will be represented by men whose names are associated with enterprises of which any people might well be proud. Every railway and river on which they travel, and every city they visit, are witnesses to the skill, patience, energy, and learning of this assemblage of experts, who see whatever there is to be seen with intelligent eyes and minds, who think for themselves, and who are about as appreciative a class of excursionists as can be brought together. The civil engineer is a very important factor in the community, and never more so than at present, when accumulated capital is awakening to new and great enterprises for the peaceful conquest of hitherto uncultured fields, the van of which must be led by the profession, some of whose members are now intent on taking all the pleasure possible out of their well-earned vacation.

## PERSONAL.

Max Boehmer, U. S. Dep. Mineral Surveyor, of Leadville, Colo., has published a topographical map of the carbonate regions of Leadville, showing location of mines and prominent prospects, from actual survey. This map is certainly a very fine one, and cannot fail to be of interest to all

who have money sunk in the neighborhood of Leadville. And who hasn't?

H. C. Thacher, former City Engineer of Toledo, O., has formed a partnership with the well-known sub-marine diver Geo. H. Breymann, of that city, and we publish their new advertisement elsewhere this week. Mr. Breymann has just returned from Saratoga, N. Y., where he has been engaged in placing an extension of the influent pipe, and building a crib, for the water-works of that place

Mayor Grace, Comptroller Campbell and President Keenan, of the Board of Aldermen, on the 8th, named the following representatives of New York City on the Board of Trustees of the East River Bridge: John T. Agnew, John G. Davis, Robert B. Roosevelt, Erastus W. Smith, J. Adriance Bush, Henry Clausen, Thomas C. Clark and Charles Macdonald. Messrs. Clark and Macdonald are new appointments.

Mr. Chas. J. Moore, civil and mining engineer, of Leadville, Colorado, returned recently from England, where he has been spending a few months. Mr. Moore, who was formerly located in this city, later in Chicago, Ill., and Des Moines, Ia., has been very successful in Leadville, and has already acquired a most enviable reputation for his abilities as a mining expert.

We were pleased to receive a call this week from Col. A. F. Wrotnowski, of New Orleans, who is spending his vacation in the North, and who will go to the Montreal Convention by Niagara Falls. Col. Wrotnowski reports an unusual amount of engineering activity in New Orleans, principally in street improvements and in preparation for the sewer building that will commence as soon as the hot weather is over.

G. Thomas Hall, C. E., died on the 2d inst., after a long and painful illness.

Captain Hall, as he was familiarly called, was born at Ballston Spa, in 1845; graduated as a civil engineer at the Troy Polytechnic School at an early age and has been in the active practice of his profession until the beginning of his sickness, some four months ago. He was engaged on the preliminary survey for the Gilbert Elevated Railroad; was absent from the city during the period of inaction that prevailed in rapid transit matters, but returned when construction began, and has been identified with the Metropolitan and Manhattan railway interests as Division Engineer ever since.

He became a member of the American Society of Civil Engineers in 1874, and an interesting and valuable paper on "Elevated Railways and their Construction," referring particularly to the Second avenue structure, of which he had direct supervision, was read before the Society during his illness, and will be published in a short time.

The funeral service was held at his late residence, 888 Ninth avenue, Sunday afternoon, and was attended by a delegation of the American Society of Civil Engineers and a body of his associates in the employ of the Manhattan Railway Company, with whom he was exceedingly popular.

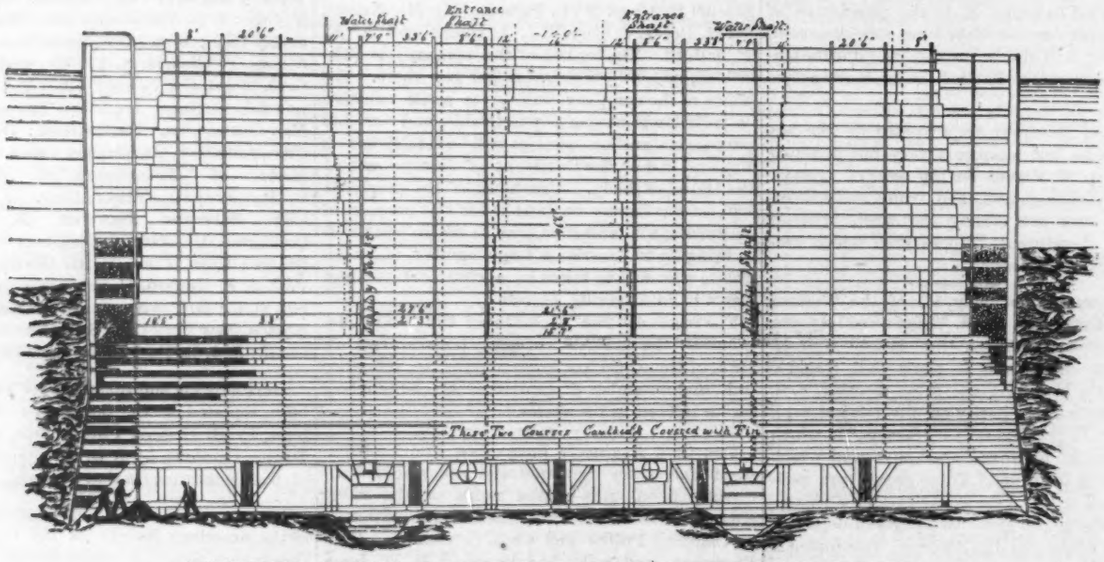
He leaves a widow and a large circle of personal and professional friends to mourn the early decease of an unusually genial associate, and one who had already achieved a high rank in the profession to which he belonged, and whose past career gave promise of a brilliant future.

## THE NEW YORK AND BROOKLYN BRIDGE.

(*Continued from page* 224.)

### SOUNDINGS FOR ROCKS.

At a depth of 70 ft. soundings were begun in the air chamber for the location of bed rock, by means of a pointed rod 10 ft. long, driven in by sledges. These revealed a stratum of cemented gravel over the entire area at a depth of from 77 to 80 ft., and above and below this a great number of boulders, many of them of large size. This was the first material reached which could sustain the tower, and bore certain evidences of not having been disturbed. The settlement of the Brooklyn tower on a similar foundation, with two-thirds of its ultimate load upon it, had been only three-eighths of an inch; it was therefore decided to stop excavation at a depth of 78 ft. For about 60 ft. on one side of the caisson, the bed rock was encountered at 77 ft.; this was blasted out one foot below the shoe, and the space filled in with earth.




NEW YORK CAISSON. LONGITUDINAL SECTION TEN FEET FROM EDGE.

### FILLING.

The filling was done as in the other caisson, except that the greater supporting power of the frames rendered the brick piers superfluous, and they were dispensed with. In filling, the spaces under the frames were first made solid; then, wherever there was quicksand under the shoe, a trench was cut down to the gravel layer mentioned, and filled with concrete. After this the filling was carried on by sections, bulkheads being put up for the purpose. Enough stones and earth were left below to reduce the amount of concrete required to 3,300 yards, about the same amount as in the Brooklyn caisson. The filling in took place in such a manner as to leave the final exit by means of the water-shafts. Several trials were made to take off the air pressure before the filling was completed, but the water invariably came in after the pressure had been reduced below 30 pounds.

One month was consumed in removing the water shafts, air shafts, inner coffer dam, and outer shores, and in filling the two large well holes and other shafts and smaller pipes with concrete, and in completing the dock around the tower.

### LIGHTING.

The subject of satisfactorily illuminating a chamber filled with compressed air has always presented many serious difficulties. A powerful light is required to overcome the want of reflecting surfaces—which are inadmissable because of the mist deposited upon them—to penetrate the thick mist usually present in such places, and to illumine every foot of an uneven soil. The burning of candles is attended with an intolerable amount of smoke, resulting from incomplete combustion. In regard to candle smoke and the method of lighting the Brooklyn caisson, Col. Roebling in his first report remarks:

"This nuisance (*candle smoke*) was overcome somewhat by reducing the size of the wick and of the candle, and by mixing alum with the tallow and also steeping the wick in vinegar. The inhaling of so much floating carbon is very injurious to the lungs, as the lampblack remains in them for weeks and months; nevertheless, candles had to be used more or less for all special work requiring illuminating close by. Lamps are of little account since they smoke more than candles, and the oil is dangerous in case of fire.

Fortunately, the existence of an establishment in New York for the production of oxygen gas in large quantities, and at moderate prices, made the introduction of calcium lights quite feasible.

For a time, cylinders filled with compressed oxygen gas and compressed coal gas, were lowered into the caisson and there used. The danger, however, of breaking a freshly-charged cylinder was too great on account of the risk of an explosion. A double system of pipes was therefore put up in the air-chamber, one for oxygen and the other for coal gas, which takes the place of pure hydrogen. In the end of each chamber was one burner, and a special one next to the water shafts, making fourteen calcium lights in all. In addition, there were sixty burners for common street gas, which was used whenever the supply of oxygen failed. The two gas mains passed to the outside of the caisson, where they connected with two tanks. In order to make the system effective it was necessary to have the gas pressure always one pound, or thereabouts, in excess of the air pressure in the caisson, and also, to maintain this as

the caisson sank. For this purpose the two gas tanks were filled with water from an artificial reservoir, having a head always slightly in excess of the caisson pressure. Into these tanks the gases were discharged from smaller cylinders, under a pressure of 225 pounds. The immediate effect was to force the water from them back into the reservoir, until the tank was full, when the supply was stopped. The pipes leading to the caisson remained open, and the gas passed through them under the pressure due to the artificial head of water. By means of glass gauges the contents of the tanks would be watched and replenished as often as necessary. As the caisson sank, the reservoir was raised from time to time. This was rather troublesome, and was avoided in the New York caisson by placing the gas tank below in the air chamber, otherwise a tower of 80 feet in height, would have to be built by degrees. The gases could, of course, have been pumped directly into the tanks, were it not that the stroke of the pump creates an unpleasant jumping of the flame. The oxygen gas was delivered in a compressed state, and the coal gas was compressed on the spot. When the oxygen gas was of good quality, two calcium lights were sufficient for one chamber 102 feet long by 30 feet wide. The heat produced is less than that of a gas flame, and the product of combustion water. One attendant was sufficient for 14 lights, besides all the gas lights. The lime-ball requires occasional turning, as it wears away by the action of the flame, and also requires frequent renewal when water condenses in the pipes. The blow-pipe burners are apt to burn out and get out of order. The explosive flame will also run back and melt the rubber connection. In short, quite an apprenticeship is necessary to adapt the calcium lights to all the new conditions. The only danger lies in leakage of pipes and from carelessness in leaving the cocks open. One gas explosion took place below, sufficient to singe off whiskers and create some alarm. The sense of smell is so blunted that the leakage of coal gas is not easily detected. But the ordinary gaslights were found to be the most economical. Their cost is only one-fifth of the calcium light, and about one-third of candles. * * * They produce, however, an intolerable amount of heat, and vitiate the air more than candles, although producing but little visible carbon."

In the New York caisson the gas-burners first used were 5-ft., fish-tail, which burned with a flickering yellow light, consuming much gas and smoking nearly as bad as candles. Experiments were commenced, and it was found that a 2-ft. lava tip, of the pattern known as the "excavated bat wing," burned with a clear white light, giving off scarcely any smoke. As the depth increased these also smoked, and 1-ft. burners were substituted, when no further difficulty was experienced. Under a pressure of 35 pounds these burners gave as much light as a 4-ft. one outside.

PHYSIOLOGICAL EFFECTS OF COMPRESSED AIR.

Col. Roebling in his report states that in but two instances could death be directly traced as the effect of pressure. "It is true that scarcely any man escaped without being somewhat affected by intense pain in his limbs or bones, or by a temporary paralysis of arms and legs; but they all got over it, either by suffering for a few days outside, or by applying the heroic mode of returning into the caisson at once, as soon as the pains manifested themselves, and then coming out very slowly."

As the pressure increased the working hours below were gradually reduced as follows: Seven and one-half hours at 45 feet; seven hours at 50 feet; six hours at 60 feet; five and one-half hours at 70 feet; five hours at 71 feet; four and one-half hours at 76 feet, and four hours at 77 feet, divided into two shifts.

(TO BE CONTINUED.)

Not one proposal was made "for the removal, transfer and erection of the West Philadelphia standpipe and for the erection of a new standpipe near the Schuylkill Water-works." Chief Engineer McFadden was requested to readvertise for bids within ten days. The Committee on Extensions recommended the appropriation of $80,000, for the laying of fifteen thousand feet water pipe at a cost of $77,988, in order to afford better facilities for the distribution of water throughout the city, which was adopted.

## THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 204.)

INDIANAPOLIS (CONTINUED.)

A Holly engine, with four inclined steam cylinders of 34-in. diameter connected to a fly-wheel and working four double-acting pumps of 15 in. bore and 37-in. stroke, was erected in 1880. The old rotary and gang pumps are badly worn.

The distribution pipes are of cast iron. Forty-three miles are in use. The first pipes were laid without much system and the principal main was of insufficient size. The principal use of water has been for fire purposes, for which the city pays $50 per year for each fire hydrant, of which 601 are in use. For street and lawn sprinkling, and for domestic supply the number of taps is about 1400. The water is also used by several manufacturing establishments and for 12 hydraulic elevators.

The use of meters was tried, but the water clogged and corroded them to such an extent that out of 150 which were in use, all but 25 have been removed.

The report of the company for the year ending Sept. 30, 1880, showed the receipts for the year to have been $75,064.49 and the expenses $66,018.77, and outstanding bonds to the amount of $1,100,198.24. For three years ending Sept. 30, 1880, the receipts were $213,482.75, and the expenses, exclusive of interest on the bonds were, $137,664.24.

Since that time the works have been sold under foreclosure and a new company organized, and preparations made for procuring a supply of pure water at small cost. The Vice-President and Superintendent of the works is Sidney M. Dyer.

The quantity of water consumed, if estimated by the capacity of the pumps, is about 4,000,000 gallons per day. It is not practicable to make even an approximation to the amount really pumped, however, by engines of the direct-pressure system.

The ordinary domestic pressure is 45 lbs., and the fire pressure 110 lbs. on the gauge in the engine house.

XXIII.—ROCHESTER.

Rochester, New York, in lat. 43° 8′ 17″ n., long. 77° 51′ w., is situated on the Genesee River, 7.3 miles from Lake Ontario, and 263 ft. above it. The city lies on both sides of the river, in which there are three falls of 96, 26, and 83 ft. respectively, in passing through the city, furnishing a valuable water power which has been utilized in the construction of the water-works.

The rock on which the city is built is lime-stone, and the water of the river and of all the wells is very hard.

Settled in 1812, and incorporated as a city in 1834, its population in 1860 was about 60,000, when a private company first chartered in 1852, undertook the construction of a wooden conduit to bring water from Honeoye Falls, 14 miles distant, after the plans of Daniel Marsh, C. E. The conduit was circular, and formed of pine staves hooped with iron. A reservoir of 20 acres area, 8 miles from the city, and a distributing reservoir in the city, were partly built. The conduit would not hold water when the attempt was made to fill it.

In 1873–6 works were constructed by the city after the plans and under the superintendence of J. Nelson Tubbs, C. E. Water is taken from Hemlock Lake, 28 miles south from the city, and 388 ft. above the Erie canal in the city. The Lake is 6.7 miles in length, and six-tenths of a mile in width, with a depth of from 45 to 90 ft. Its area is 2.15 square miles, and that of its water-shed 42.39 square miles. It lies in a valley surrounded with steep hills, the soil of which is underlaid with a sort shale. The water of the lake is very soft.

Canadice Lake, in a valley east of and adjacent to the Hemlock Valley, is also tapped. It is 3.1 miles long, and $\frac{1}{3}$ mile wide, with an area of 1 square mile.

The conduit from Hemlock Lake to Rush reservoir is constructed of cast-iron and wrought-iron pipe. At the lake a timber crib is placed in 36 ft. depth of water 1,000 ft. from the shore. The conduit beginning at the crib is of 36-in. wrought-iron, riveted pipe, 700 ft. of which nearest the shore was laid in a trench in the bottom of the lake by means of coffer-dams. From this point three sections were laid of 97, 100 and 74½ ft. in length, respectively, connected by ball and socket joints, the outer end of the last being funnel shaped. To prevent the pipes sinking in soft places on the bottom of the lake, timber platforms were placed underneath.

The crib is a timber box, formed of pine and oak timbers, 6 in. wide and 12 in. high, bolted together; it is 12 ft. square and 9 ft. high; its bottom is composed of oak planks 3 in. thick, and the top is covered with an iron screen; the crib is weighted down with stone. The conduit continues of wrought-iron of 36-in. diameter for 49,776 ft. from the shore toward the city, in which distance it falls 27 ft. The next section is of wrought-iron pipe of 24 in. diameter for 1,913.65 ft., the third section is of cast-iron pipe of 24 in. diameter for 30,549.75 ft.; the fourth section is of wrought-iron pipe of 24 in. diameter for 13,809.38 ft., and the fifth section is of cast-iron pipe of 24-in. diameter, for 5,222.27 ft. to the gate-house of the Rush reservoir, the flow line of which is 242 ft. above City datum and 143 ft. below Hemlock Lake.

The pipe follows the surface of the ground, which is undulating, being in some places 340 feet below the hydraulic grade line. In 1879 a break occurred in one of the 24-in. cast-iron pipes on this line near Honeoye Falls, and several joints were reported as being started.

From Rush reservoir to Mount Hope reservoir, a distance of 46,064 ft., a 24-in. cast-iron main is laid. The difference of level between the two reservoirs is 127 ft.

During the filling of the Rush reservoir, on its completion, measurements were taken of the discharge of the 36 and 24 in. conduit which showed a larger delivery than the old formulæ for flow of water in pipes would give; but the experiments do not appear to have been continued long enough to give any valuable data for comparison.

The storage reservoir at Rush, ten miles from the City Hall, is in excavation and embankment. The banks are 23¼ ft. high above the bottom of the reservoir, and are 16 ft. wide on top. A puddle wall is built through their centre 10 ft. wide for a height of 8 ft. from the bottom of the trench, and thence to the top, 6 ft. wide, for a height of 12 ft. The wall extends about 10 ft. below the bottom of the reservoir. The outside slope is 2½ to 1, and the inside 2 to 1, with a level break of 5 ft. at a depth of 7 ft. below the water line, which is 4.25 ft. below the top of the bank. The inside slope is covered with rip rap 2 ft. deep, laid over a gravel lining 12 in. deep. The bottom has 18 in. of puddle, and over this 8 in. of gravel. The effluent pipe is laid in a masonry gate structure at the centre of the reservoir. The area is $13\frac{771}{1000}$ acres, and the capacity 80 million gallons. The elevation of its flow line is 242 ft. above the Erie Canal at the city, and the depth of water 19 ft.

The distributing reservoir is at Mt. Hope, one and three-quarter miles from the City Hall; it has earth embankments and is constructed in the same manner as the Rush reservoir, its banks being 20 ft. high above the bottom of the reservoir, and 16 ft. wide on top. The depth of water is 15 ft. Its flow line is 124.4 ft. above the Erie Canal in the city. Its area is $5\frac{511}{1000}$ acres, and its capacity is 35 million gallons. The influent pipe enters a masonry gate-house in the centre of the reservoir, the discharge

* Copyright 1881.

under the head from Rush reservoir forming a fountain jet. The effluent and influent mains are so connected that water from Rush reservoir can be turned into the city distribution, thus greatly increasing the head in the pipes, and on every alarm of fire in the city this additional head is turned on with very satisfactory results.

The business part of the town is also furnished with a direct pressure system of pumps and pipes for fire protection and hydraulic motors, indepenent of the Hemlock Lake supply.

Water is taken from the Genesee River and pumped into mains by a Holly steam engine, with cylinders of 16-in. diameter and 27-in. stroke, arranged to be run as compound, low or high pressure, and operating four double-acting pumps 10 in. in diameter and 20-in. stroke. There are also two rotary engines operating two rotary pumps for fire streams.

Besides these there are eight double-acting pumps arranged in two sets, each having four cylinders of 9 in. in diameter and 24 in. stroke. These are operated by two turbines of 24-in. diameter, working under 90 ft. head.

These turbines wore out and were replaced by new ones in 1879. The water is conveyed to the wheels by a vertical wrought iron-flume of ¼-in. iron, 4½ ft. diameter.

The steam pumps have a capacity of three million gallons and the water set of four million gallons capacity in 24 hours. These works went into operation January, 1874, with eight miles of pipes.

All distribution pipes are of cast iron, coated with Smith's preparation. There were 104.35 miles laid to April, 1880, of which 96 miles were on the Hemlock Lake service, and the rest on the direct pressure service.

The Genesee River is crossed on Main street bridge by four 12-in. pipes. The extrados of the arches being within 4 ft. of the roadway, part of the crown of the stone arch was cut out and an iron structure, arched to correspond with the remaining stone arch, substituted, through which, and in the masonry over the piers, two compartments of cast iron 3 ft. by 3 ft. 2 in. were made. Through each of these two wrought iron riveted 12-in. pipes, ¼-in. thick, were carried, each pair branching at each end of the bridge from an 18-in. cast iron pipe with slip joints at the ends. They are packed in fine charcoal for protection against changes of temperature.

The use of meters began in 1878, in which year 82 were set. The number in 1880 is not given, in 1879 it was 100.

In 1880 the population was 89,363, 104.3 miles of pipe were in use and the consumption was 5 million gallons daily. The works were built under a Board of Water Commissioners, reporting first to the Common Council, but afterward to the Mayor. In 1876, by act of Legislature, an Executive Board of six members was constituted, three to be elected by the people, and three appointed by the Mayor.

J. Nelson Tubbs, C. E., is the Chief Engineer.

### XXIV.—LOWELL.

Lowell, Massachusetts, is on the Merrimack river, 26 miles N. W. of Boston. The business part of the city is low and flat, but the environs are elevated and afford fine sites for residences. The corporate limits comprise about 4 square miles. The existence of the city at this point is determined by the facilities for manufacturing offered by the great water power afforded by the rapid descent of the Merrimack, which here brings down the drainage of 4,136 square miles. The first mill was erected in 1822, the city was incorporated in 1836, and in 1870, the population being 40,000, the construction of water-works was begun after the plans of Joseph P. Davis, C. E. Water was introduced in 1873.

Water was taken from the shore of the Merrimack River. A gallery 1,300 ft. long and 8 ft. wide was excavated in gravel parallel to and 100 ft. distant from the river. Parallel walls of rubble masonry 8 ft. apart and 5 ft. high, support a semi-circular brick arch. At the bottom, stones 1 ft. square and 8 ft. long, placed 10 ft. apart, between centres, keep the walls apart, and the space between them is filled with coarse, screened gravel. The walls and arch are laid in cement mortar. The bottom is on a level with the dam across the river, below the gallery. Three manholes are carried to the surface of the ground. The ground water from a narrow tract of intervale land, varying in width from 300 to 3,000 ft., underlaid by a mixed stratum of gravel and sand, enters the gallery from the bottom.

To provide for drawing water directly from the river in case of insufficient supply from the gallery, an inlet chamber was built 17½ × 38½ ft., with a wing 13½ × 15½ ft. with walls of cut granite and rubble masonry laid in cement. A cast iron 30-in. pipe 220 ft. long, with two self-acting gates, connected the river with the gallery. The inlet pipe extended 45 ft. into the river, resting on a grillage of piles and strapped down. A screen and gate were placed at the outer end and another gate 136 ft. from the chamber.

From the chamber a circular brick conduit of 51 in. diameter, laid in cement, extends 4183 ft. of which 1,788 ft. were in tunnel through rock to a terminal chamber, 11 × 15.5 ft. The tunnel was mostly in rock, was worked from 3 headings. Its sides are vertical for 4 ft., and it is 4 ft. wide. Brick lining was necessary for 733 ft.

From the terminal chamber a 30-in. cast-iron pipe was laid 6,554 ft. to the engine house. Across Beaver Brook the pipe was laid across the bed of the stream for 100 ft. in a coffer-dam.

At the lowest point a man-hole pipe 14 ft. long was placed with a 6-in. blow off pipe 3½ ft. below its top.

A test was made of the yield of the filter gallery in the summer of 1873, and it was found to be 150 gallons per sq. ft. of bottom area in 24 hours. In August, 1874, the gallery was exhausted by pumping for 31 consecutive days at the rate of 939,860 gallons per day, and a similar trial, under like conditions, for 30 days in April, 1875, showed a yield of 959,768 gallons per day. To obtain this yield required constant pumping, but as during the year the consumption required pumping for only 75 per cent. of the time the real yield was estimated at 700,000 gallons per day. The consumption varied from 920,000 to 1,400,000 gallons per day, and the excess over the yield of the gallery was drawn directly from the river after September, 1874.

In 1876 a filter-bed was constructed between the gallery and the river. The bed is rectangular, about 100 × 114 ft. on the bottom, which is 8 ft. below the level of Pawtucket dam, and in gravel. On the gravel is laid a dry-stone drain 15 in. square at the river end and 30 in. square at the end next the gallery, where it terminates in a circular brick chamber 10 ft. in diameter, from which a 30-in. pipe leads into the gallery. From the central drain 27 lateral stone drains are laid, each 8 × 12 in. The drains are covered with cobble stones 8 to 3 in. in diameter, for 36 in, then with 10 in. of screened gravel from 1 to 2 in. diameter, then with 10 in. of gravel of 1 to 1½ in. size, then with 6 in. of pea-size gravel, then with 4 in. of coarse screened sand, and lastly, with 18 in. of fine sand. A timber trestle-work, planked on the side from the cobble-stones to the sand surface, and above fitted with folding flash boards, separates the filter-bed into two parts, the inner one of 7,150 square ft., and the outer, next to the river, of 2,850 square ft. This filter was put in use in December, 1876. A freshet in the spring of 1877 deposited 18 in. of sand and silt on the bed, and it was necessary to admit some water directly from the river until September, when the surface was cleaned off, and for 83 days the filter bed and gallery furnished the full supply to the city, the consumption at that time being about 1¾ million gallons per day.

In 1878 the filters furnished a full supply for 43 days, the amount pumped in that time averaging 1,879,810 gallons per day. It was found that with one inch of silt on the filter very little water could be obtained. From August, 1878, to June, 1879, the surface was not cleaned, by which time 20 inches of silt had accumulated. After being cleared it supplied the gallery for nine days when an inch of silt had accumulated and stopped it up entirely. The cost of cleansing was $93.96, and the superintendent estimated that to make the filter available for constant use it would have to be cleaned three times a month, at a cost of $25 for each cleaning, and that could only be done at any rate when the river was low and free from ice, or from June 1 to Dec. 1. It was cleaned no more.

The conduit and pipe from the gallery terminate in an arched pocket 35.5 by 10 ft. covered with a brick arch over which is the engine foundation, the whole resting partly on timber foundations and partly on rubble masonry supported on 82 piles, driven 20 ft. A passage in the engine foundation wall leads from the pocket to the pump well which is 35x13 ft. and 18.17 ft. deep. The first pumping engine is a beam and fly-wheel compound condensing engine, with low pressure cylinder of 57-in. diameter and 96-in. stroke, and high pressure cylinder of 36-in. diameter and 61⅜-in. stroke. The pump is a Thames Ditton bucket and plunger pump with 36-in. bucket and 25.45-in. plunger of 60-in. stroke.

A Worthington compound duplex engine of five million gallons capacity was erected in 1875. The water is lifted 157 ft. in a 36-in. force main for 2,666 ft. to the reservoir, which is 520 by 510 ft. at flow line and 24 ft. deep, built in excavation and embankment.

The banks are built of puddling gravel, put in in 6-in. layers, wetted and rolled. The inside slopes are lined with 2 ft. of puddle, on which is 10 in. of broken stone, covered with dry granite paving 15 in. thick. The bottom is covered with 12 in. of puddle. The influent gate-house is fitted with a weir to measure the actual quantity of water pumped. The reservoir has not leaked.

The distribution pipes laid by the Water Board are all of cast-iron, coated with Dr. Smith's preparation. A 30 in. main was laid in 1873 across the river where its bed was of boulders and clay, underlaid with quicksand. A coffer-dam was built and the water kept out by steam pumps.

Before the construction of the present system several lines of wrought-iron and cement pipe had been laid in the city for fire protection, which were afterwards incorporated in the distribution system; 2,037 ft. of this pipe which had been in use 13 years were taken up in 1880, being found to be badly corroded and leaking. It was replaced with iron pipe. There were, on Jan. 1, 1881, 62.97 miles of pipe laid and 672 hydrants.

The use of meters was begun in 1872. There were 708 in use on Jan. 1, 1881. The daily consumption in 1880 was 2,252,197 gallons, the number of water-takers 12,198, and the population 59,485.

For construction of the works three Water Commissioners were appointed in Jan., 1870, for a term of three years.

In 1874 a Water Board was established consisting of three members of the Common Council and two citizens at large, elected by the Common Council.

The City Engineer, George E. Evans, is engineer to the board.

D. P. Griffin was superintendent from 1873 to 1878, and Horace G. Holden from 1879 to 1881.

### XXV.—PITTSBURG.

Pittsburg, Pennsylvania, in lat. 40° 26′ 34″ N.,

long. 80° 2′ 38″ W., occupies a triangle formed by the confluence of the Allegheny and Monongahela rivers, forming the Ohio. The city extends about seven miles on each river and covers 22 square miles. A narrow strip along the river banks of $5\frac{16}{100}$ square miles area rises from the river level to 120 ft. above it, and is occupied by manufactories and business houses.

Between 120 and 250 ft. above the river there are 8.61 square miles largely occupied by residences. Between 250 and 400 ft. elevation there are $7\frac{66}{100}$ square miles, and a small area lies more than 400 ft. high, two summits being about 520 ft. above the rivers. A steep hill side on the south side of the Monongahela River is also included within the city limits.

The site was first settled by the English in 1754 as a military post. A village was begun in 1758, which in 1816 was incorporated as a city.

In 1824, the population being about 12,000, water-works were built by the city. The water is taken from the Allegheny River, about a mile above its mouth, and pumped into a reservoir on Bedford avenue, 135 ft. above the river. The first pumping engine was of one and a half million gallons capacity. At different times other engines have been added, and for several years there have been four engines at these works, all thoroughly worn out now. The two older engines, called Hercules and Sampson, are direct-acting, high-pressure engines, on an incline, the pumps being under water and the connecting rods of wood.

The water is taken directly from the river in two 29-in. cast iron pipes extended into the stream, through which drift wood and gravel are at certain stages of the water drawn into the pumps, causing many accidents. The pumps have a total estimated capacity of eighteen million gallons per day.

At the Bedford avenue reservoir three pumping engines are placed, which force water into the old high service reservoir, 398 ft. above the river. Two horizontal non-condensing engines are geared to a shaft, the cylinders having 15-in. diameter and 72-in. stroke, and the pumps 11-in. bore and 72-in. stroke. These engines were built about 1845. In 1869 a Lowry engine was added, with 26-in. cylinders of 96-in. stroke, working two pumps of $18\frac{3}{4}$-in. bore and 72-in. stroke.

Beneath the old high-service reservoir and 10 ft. below its bottom, runs a vein of coal 4 ft. thick, which has been on fire some years, burning toward the reservoir. In 1879, the fire seemed to be coming so close as to be dangerous, and the City Engineer, Mr. Alexander Dempster, attempted to intercept the fire by a trench near the reservoir. The heat and gas were so great in the pit which was dug that the men could not work. The pit was then flooded with water from the reservoir, and kept flooded until the fire was extinguished.

In 1872 new works were begun after the design of E. S. Chesbrough and Moses Lane, and water was introduced from them in 1878. The plans of the engineers were not entirely adhered to in construction. The new works are situated at Negley's Run on the Allegheny River, about ten miles above the point. Four engines of 64-in. cylinders and 168-inch stroke, each operating two plunger pumps of 40-in. bore and 135-in. stroke, lift the water 335 ft. into the Hiland avenue reservoir.

(TO BE CONTINUED.)

Received from A. Dempster, City Engineer, Pittsburgh, Annual reports of Pittsburgh Water-works for 1877, 1878, 1879. From S. M. Dyer, Vice-President and Superintendent Indianapolis Water-works, first and second reports of Water-works Co., of Indianapolis, for 1871 and 1872. From Hiram Nevons, Superintendent Cambridge Water-works, reports of Cambridge Water Company, 1857 and 1861; Reports of Cambridge Water Board, 1867, 1869, 1872, 1873, 1877. From C. G. Darrach, report of Philadelphia Water Department for 1880. From F. Doherty, Superintendent, reports of Columbus, Ohio, Water-works for 1872, 1873, 1878, 1879. From George E. Evans, City Engineer, Seventh report of Lowell Water Board for 1880. Twenty-sixth annual report of the Water Commissioners of Troy, New York, for year 1880.

## CORRESPONDENCE.

### CORRECTION.

BRAZIL, Ind., June 6, 1881.

EDITORS ENGINEERING NEWS:

I notice in your issue of May 28 you say that D. C. Jenne, formerly Resident Engineer Hennepen Canal Improvement, has accepted the position of Treasurer and General Manager of the Brazil Block Coal Company, and may be addressed at Brazil, Ind. I desire to say that I never held the *honorable* position of Resident Engineer of the Hennepen Canal Improvement, but have held the position of Chief Engineer of the Canals and River Improvements of the State of Illinois for nearly nine years, and hold the same position, nominally, at the present time.

D. C. JENNE.

### PROBLEM IN GEODESY.

MASON VALLEY, ESMERALDA CO., NEV., June 4, 1881.

EDITOR ENGINEERING NEWS:

Will you please favor me by granting a place in your paper to the following questions:

(1) What is the best method of running an East and West line when a good degree of accuracy is required, as, for instance, a state or county boundary, and the surveyor has no other instrument except a first-class engineer's transit (that is no astronomical instruments).

(2) If the above line is run at right angles to the meridian of the starting point, and posts set at one mile, what will be the offsets at each mile in latitude 39° N., that is, what distance would each stake have to be set north at (1), (2)—(10)?

J. M. HOUSTON.

### POCKET TELEMETER.

NAPANEE, ONT., June 6, 1881.

EDITOR ENGINEERING NEWS:

In looking up the subject of Micrometers I came across a description of a "Pocket Telemeter" in the ENGINEERING NEWS of March 25, 1876, by M. Gaumet. Will you or some of your readers tell me where it can be obtained?

As the subject of Micrometer measurements is of more than ordinary interest, perhaps some of your readers would kindly furnish the results of their experience, (1st) With ordinary fixed stadia wires, (2d) With movable stadia wires, (3d) With "Rochon Micrometer" or any other form of micrometer they may happen to be acquainted with, and oblige yours truly,

MATTHEW J. BUTLER.

[In Vol. II., ENGINEERING NEWS, 1875, there are several articles on Stadia Measurements, and on page 16 is a valuable communication from Prof. Robert Bell, of the Geological Survey of Canada, on the Rochon Micrometer Telescope as a surveying instrument, in which Prof. Bell gives his personal experience. We regret to say that Vol. II., ENG. NEWS is out of print and unattainable.—ED. ENG. NEWS.]

## ENGINEERS' CLUB OF PHILADELPHIA.

RECORD OF MEETING JUNE 4, 1881.

Vice-President Henry G. Morris in the chair, 18 members and two visitors present.

Prof. L. M. Haupt read some notes on Cobble Stone Pavements, commenting on the great variety of size and form as exhibited in the streets of this city. He gave extracts from the Ordinance of June 12, 1868, specifying the size of such stone to be not more than "9 or less than 6 inches in depth, or showing a greater length of face than 7 or less than 4 inches," and then stated the characteristics of one "cobble" which he took up, weighed and returned to its position. It was found to be 38 inches long by 25 wide by 10 deep, to contain 4 cubic ft. and to weigh 625 pounds, or one hundred times the weight and volume of the average stone as specified.

The form of cobble stones, being spheroidal, was also shown to be unfavorable to resist the forces which act upon them, and the practical absence of friction between the surfaces of contact render them unstable and entirely unfit to perform the duties required of a good pavement.

The porosity of such a surface covering, admitting water freely to the substructure of gravel, loam and clay, which expands forcibly in winter, raising the entire surface, and shrinks away under the influence of the spring temperature, leaving the stones unsupported, was mentioned as another element of destruction and expense; and altogether it was concluded that the cobble stones were unstable, unsafe, unclean and ultimately more expensive than well laid Belgian blocks having concrete foundations.

Prof. Haupt also read a brief discussion on the methods of expressing the scales of maps and of determining their relations to each other, so as to avoid ambiguity, giving a sample formula applicable to any case.

Mr. Frederic Graff exhibited an ancient map of Philadelphia, made to show the location of the early hose companies of the city.

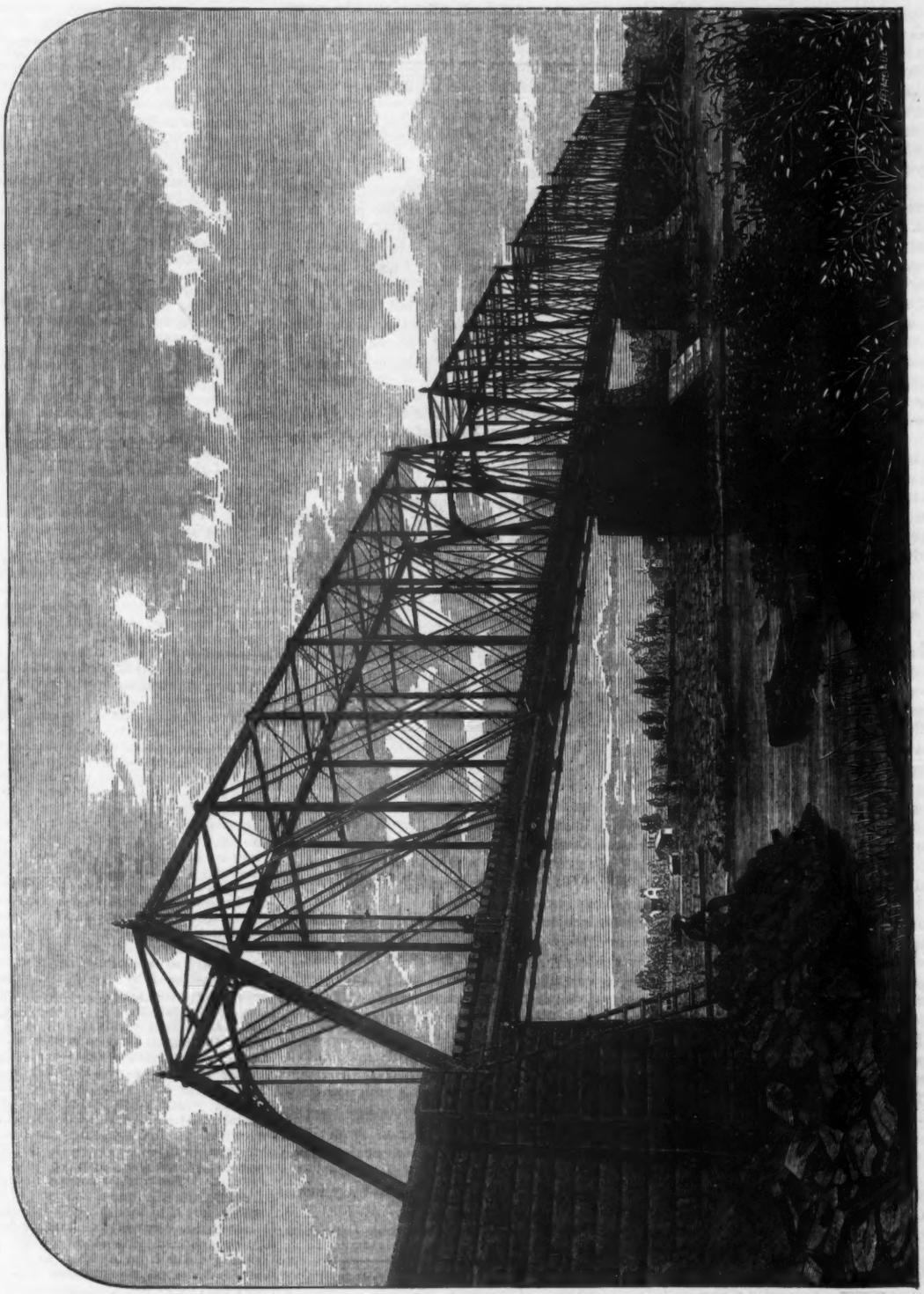
A letter descriptive of the recent sad tragedy in a corps of engineers in Mexico, was read.

HOWARD MURPHY, Secretary.

## CHAUDIERE BRIDGE, OTTAWA.

The difficulties to be overcome in building a bridge in the neighborhood of Ottawa City were unusual, and where expense was a necessary consideration, almost appalling. The Ottawa is not only one of the largest rivers on the continent, seldom, in any part of its course, less than a mile in breadth, but it is subject to sudden and dangerous rises of water, to wild floods, and at the season when the ice breaks up, to terrific jams and destructive conditions, which render the permanence of any work, however strongly constructed, in most situations hazardous and uncertain. From Aylmer, eight miles up the river from Ottawa, is a continuous dangerous rapid, which terminates at the capital in the celebrated Chaudière Falls, and immediately below the river expands into a broad deep basin, the crossing of which for miles below the city would be attended with enormous expense, and involve a very high, as well as a very long, bridge. The question was therefore between a shorter bridge at a lower level in the dangerous rapids above the falls, or a long high structure in the deeper but still water below them, where the river widens out to its normal breadth; and after carefully weighing all the considerations the upper site was chosen, and the work has been satisfactorily completed, and with a very much less loss of life or property than usually takes place in the construction of a work of this magnitude, apart from the unusual dangers that made this situation apparently so extremely hazardous. The route as finally selected by Mr. P. A. Peterson, the engineer, leaves the Quebec & Occidental Railway at the Hull Station, 117 miles from Montreal, and 264 miles from Quebec, and is a little over $1\frac{1}{4}$ miles in length, to a junction with the Canada Central, just north of Ottawa City, and about half a mile from their present station at the capital. The river at this point is barely three-fourth of a mile in width from shore to shore, and near the center of the river is the rocky Lemieux Island, which is usually some few feet above the water, but completely submerged in the spring and early summer, when the foaming freshet dashes wildly over it. The site selected is only 350 yards distant from the great cataract of the Chaudière, but it has the advantage of crossing the river where the current is less wild and unmanageable than in almost any other portion of the broken water from Aylmer to the falls. In ordinary conditions the current under the bridge is only two miles per hour, not really dangerous to a well-handled boat or barge, and not materially increasing the expense of the coffer-dams and false works. Were it not for the great roaring cataract immediately below there was nothing in the current or in the nature of the river that had not been encountered in the longer and loftier bridge over the St. Lawrence at Montreal, but in the immediate presence of the remorseless fate that awaited the slightest indiscretion or mischance, this Chaudière Bridge is one of the boldest conceptions that

has yet been carried out on any railway in existence. The main channel of the river is near to the north shore about 200 feet in width, and varying in depth from 44 ft. to 56 ft. at different periods of the year. The remainder of the river



THE CHAUDIERE BRIDGE, OTTAWA RIVER, CANADA.

varies in depth in ordinary summer water from 3 ft. to 10 ft., to which at least 7 ft. must be added during the months of May and June.

The bed of the river is composed of limestone rock, and presents a very broken and irregular surface, in some places level, smooth and water-worn, in others broken off in irregular steps with transverse and vertical fissures, and intrusions of a harder and more intractable material, while the immediate sides of the main channel have a jagged and serrated edge, as if the softer portion of the rock had been worn away by the action of the water, leaving the unsupported projecting masses to be broken off by their own weight or by pressure from above. These projecting ledges of rock, with a free course for the water underneath, together with the numerous vertical cracks and fissures, appeared to render the usual process of securing a foundation for the piers by coffer-dams and pumping difficult if not impracticable. In practice, however, the vertical fissures were generally avoided, and most of the foundations were unwatered without the difficulties being very serious. The time, however, during which operations could be carried on under water was limited. The water of the Ottawa commences to rise as soon as the ice breaks up in April, and increases in volume until it reaches its maximum in the middle of June, during the whole of which period the rush of water over the proposed bridge site is tremendous, and sometimes terrific. For a month after this, as successive great rivers in the vast unexplored north break up from their winter fetters, the "freshet" continues

and work on the verge of the Chaudière cataract would be impossible, and it is generally after the middle of July before it assumes its normal condition and that works can be prosecuted. From then to the middle of December gives but a short season of five months in which these heavy foundations could be undertaken.

With all these difficulties and vast forces to contend with, and on the immediate verge of a cataract, not inferior in volume of water in the spring of the year, and scarcely even in sublimity and beauty, to Niagara itself, the rapidity with which this massive "Prince of Wales Bridge," as it is now proposed to call it, has been erected, is not one of the least interesting of the many engineering features that mark the whole grand design. The first surveys were commenced in February, 1879, and before the end of next year the locomotives were working across it. Owing to the severity of the previous winter, the ice had formed over the river from each shore, leaving only 300 ft. of the channel open. The frozen surface was marked out in squares of 50 ft., extending on to the shores on either side, and accurate soundings were taken from this grand datum level for a distance of 800 ft. above and 300 ft. below the bridge site, and in places presenting any difficulty these preliminary trials were made every 25 ft., all being carefully plotted and connected with the fixed marks on the river banks. With this information the center line was carefully marked out on the ice, the position of the various piers determined and marked off, and fresh soundings made at every point of the intended work. The highest known elevation of the water in the freshet season was ascertained to be 55.65 ft. above the rock bottom of the channel, and the lowest portion of any part of the superstructure was decided to be nine feet above this, or 64.65 ft. above the bed of the river. The piers are finished off nine inches below this for bedplates and expansion rollers, which gives a uniform height of the top of the piers and bridge abutments 63.90 ft. above datum, and allowing two feet nine inches for the depth of back stringers, nine inches for the flooring beams, four inches for the rail, 67¾ ft. is the actual height of the top of the rail from the bed of the river. The piers and abutments are all at right angles to the axis of the bridge, and the piers all finished off at the top 8 ft. wide by 24 ft. long, while the bridge seat on each of the abutments is the same length and four feet wide.

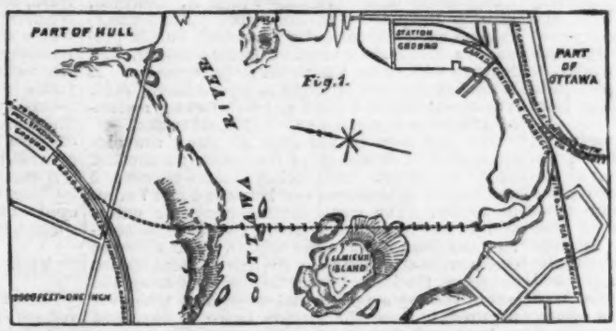
The position of Lemieux Island, and the fact that it practically diminishes the waterway of the river, determined the engineer to build a permanent embankment across this island, with an abutment at each side, thus saving about 1,000 ft. of bridge work, and dividing the structure into two nearly equal parts. The bridge was designed to be of the form known as a pin-connection through-bridge; that is, the trains were to run between the trusses on the bottom chord, with a clear headway of 20 ft. from the top of the rails to the lowest part of the overhead bracing, giving ample headroom for a man standing on the top of an ordinary box car, while the clear distance between the trusses for the passage of a train was fixed to be 15 feet. As originally intended, the spans would have been more uniform in length, but before commencing No. 2 pier, which stands near the edge of the channel, a diver was sent down to examine the sides of the chasm, and he discovered that the rock had been undermined by the water nearly 15 ft. horizontally from the edge of the channel, rendering it necessary either to remove this unsupported rock to a solid foundation, or to widen the span till a more reliable bed should be found, and this latter alternative was finally adopted. This change required the channel span to be 255 ft. in the clear, leaving one span between it and the north shore of 160 ft., and one to the south of it 135 ft., the rest being all of 150 ft. span. The openings are, therefore, from the north shore:

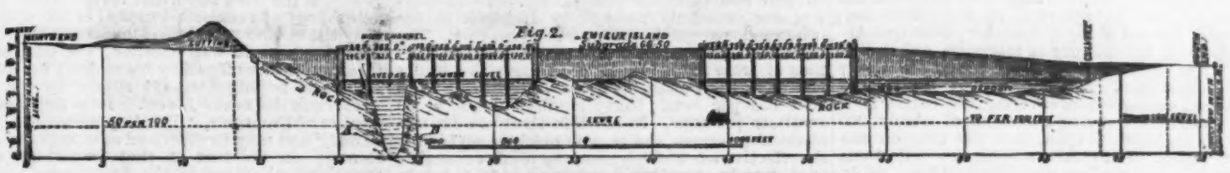
| | Feet |
|---|---|
| No. 1 span | 160 |
| " 2 " | 255 |
| " 3 " | 135 |
| " 4, 5, 6, 7 spans, each | 150 |

making, to the north of Lemieux Island, a waterway of 1,150 ft., and to the south of it, spans Nos. 8 to 13, each 150 ft., 900 ft., making a total waterway of 2,050 ft., and of iron superstructure of 2,154 ft. From back to back of the four abutments is a total length of 2,280 ft., and between the backs of the shore abutments, including the work on Lemieux Island, 3,400 ft., or over five-eighths of a mile.

In the spring of 1879 a contract was let to Mr. H. J. Beimer, based on a schedule of prices, but amounting altogether to $112,875 for the whole of the work ready for the superstructure; work commenced in the following May, and as soon as the flood subsided on the 17th of July the masonry was begun. During the summer work was in progress on all four abutments, and on piers Nos. 1, 2, 3, 4, 7, 9, 10 and 11, and 3,754 cubic yards of masonry were permanently placed in the structure. The foundations of these were all got in by the usual device of coffer-dams and pumping, and as the depth of water did not exceed for these piers 7 ft., this method was tolerably successful, although Nos. 1 and 4 required great labor and excessive pumping before they could be sufficiently unwatered to get the masonry in place. These coffer-dams were formed of 6-in. timber, braced across every 7 ft., and having an outside sheet piling of plank, between which and the timber, about 2½ ft. at the top and 4 ft. at the bottom, clay puddle well mixed with pea straw was carefully rammed down. At piers 5, 6 and 8, however, this system utterly failed, and though the coffer-dams were put in on a much heavier design than the above in shallower depths they were never cleared of water and next spring disappeared over the falls. At these piers the water varied from 12 to 16 ft. in depth, and the bottom was rugged and uneven. The method of forming a water-tight space to commence the masonry was to frame a bottomless caisson, the sides and ends of which were "scribed" to fit the inequalities of the rocks at the bottom, and being rendered elsewhere water-tight were lowered into their place and weighted with stone. Into these caissons concrete was lowered by means of a wooden box which held half a yard. About midway of the depth of the box a hinged box was fitted, which, opening in two halves, deposited on the rock bottom, within the caisson, the contents of the upper portion of the box, in the still water within the lower half, allowing the concrete to be deposited without any sensible washing away of the cement, while the buoyancy of the box when relieved from its load quickly brought it up to the surface. By this means a layer of concrete was laid in the bottom of the caisson from 3 to 6 ft. in depth, and this formed the artificial water-tight bottom for the caisson, in which, after being pumped dry, the masonry was laid without difficulty. Some experiments were made to determine the best proportions for the concrete, and also the time that was necessary to set it sufficiently to resist the disturbance of the pumps and the upward pressure of the water when emptied. As a result of these tests, the concrete was of broken stone mixed with one to one of sand and Portland cement, and after three days it was sufficiently dry to permit the caisson to be pumped out, while the surface was so hard that it required to be "pointed off" before commencing the masonry. The bottoms of Nos. 5 and 6, in 14 ft. and 16 ft. of water, were thus secured during the month of August, while the same operation at No. 8, commenced in March previously, had been excessively tedious. As the coldness of the water was apparently the cause of this, it was suggested to use steam to heat the concrete before submerging it; this proved to be efficacious in assisting the hardening, and with the use of steam a week sufficed in the coldest water to set the concrete. The caissons were so arranged that after the masonry was complete, by releasing some bolts inside, the upper part floated off, and after this was removed the foundation was protected by hand-laid rip-rap. The stone for the piers were quarried not far from the works, and was taken to each pier by scows towed by a steamer. This vessel, whose limits of navigation were probably more circumscribed than any vessel upon record, as the distance between the Little and Grand Chaudière is scarcely half a mile, was built upon the small slope of water upon which she was to work, plied successfully and without accident in the dangerous rapid between the cataracts for two seasons, and when the bridge was finished, was drawn out of the river and removed to a placid lake, where, apparently, as secure from danger as she had formerly been in its constant and immediate presence, she ended her brief existence by fire.

In the spring of 1800 the contract for the superstructure was awarded to the well-known firm of Clarke, Reeves & Co., of Philadelphia, for the lump sum of $193,078. The specification required that the superstructure of all the spans, excepting that over the channel, should be of uniform height and description, and the 255-ft. span might be higher, but was to be of the same general design. The usual plan of the firm was adopted, with the exception of the floor system, which was designed by Mr. Peterson, and applied first in this bridge, but which Messrs. Clarke, Reeves & Co. propose to adopt in their future structures. In the usual design the cross girders under each post are suspended by loops hanging from the same steel pin which receives the combined strain of the different tension members of the panel, and supports the Phœnix column or post, which in turn carries




THE CHAUDIERE BRIDGE, OTTAWA RIVER, CANADA.

from its top the different strains of the panel on either side. In this bridge the vertical columns are slotted so as to allow the cross girders to pass through them, the girders thus resting directly upon the casting which carries the column, and through which passes the steel pin receiving the different chords and braces. The arrangement saves in this bridge 22 in. in the height of the piers and abutments, giving the same headroom above the water, and effecting a stiffer and more efficient arrangement of the floor. Riveted to the cross girders by angle irons are four backstringers, 4 ft. centers and 2 ft. 9 in. deep, which run the full length of each span, and resting upon these are a series of wooden sleepers or needle beams, 14 ft. long, 8 in. by 9 in. in section, and spaced 8 in. apart, to which the rails are spiked on each side. Outside of the rails, and 7 ft. 6 in. apart, are two longitudinals, 6 in. by 7 in., let into the needle beams 2 inches, and flush with the top of the rails, and on the inside of these an angle iron 3 in. by 3 in., weighing 22 lbs. per yard, is fitted as a guard rail in case of the train leaving the rails. Outside of this again, 11 ft. apart, are two longitudinal balks of timber, 12 in. by 12 in., let into the needle beams 3 in. as an outer guard rail and walking track, and bolted down to every second sleeper, the whole being a safe, light and fireproof arrangement, strong enough to carry even an engine in case of derailment, and yet free from any accumulation of snow or ice in the winter, or danger of communicating fire from one portion to the other in case of burning embers falling from a passing engine.

The superstructure was erected by means of false works of timber built from the bed of the river, forming a temporary bridge, but some difficulty was experienced in getting this into place for the channel span, the mean current upon which, at the time of its erection, was at least four miles per hour. To counteract this the trestles were framed together on the shore, the lower portion heavily weighted with rails, and then lowered, while the upper portion was kept in place by guy ropes. The first span was swung August 28, 1880, and afterward four days sufficed on an average to get each of the others into position. Some delays, however, subsequently took place in the delivery of materials, and it was the 14th of December before the bridge was ready for the final tests. These were very severe, and comprised among others covering the entire floor with locomotives, giving a weight of nearly 200 tons on each 150-ft. span, and 300 tons on the channel span. With this weight the deflections varied on the smaller spans from $\frac{1}{4}$ in. to $\frac{3}{8}$ in., and on the long span a trifle over 1 in., returning exactly to its normal level. The total cost of the whole has been about $310,000, or a little less than $90 per foot run from bank to bank of the river.

## CLEANING THE STREETS OF PARIS.

There was received by the President of the Cincinnati Board of Public Works the following paper from General Godfrey Weitzel, United States army, who is well-known and highly esteemed in that city. It is a copy of a semi-official report of the manner in which the streets of the capital of the world, Paris are cleaned:

The cleansing of the public thoroughfares in Paris, formerly undertaken by the Prefect of Police, is now a function of the Prefect of the Seine. The staff consists of two chief engineers, one for each group of arrondissements, one group being subdivided into three sections, each under the charge of an executive engineer; and the other into five sections, similarly supervised. These sectional engineers have under them fifty-one superintendents and sixty-one overseers, whose employment imposes upon the municipal budget an annual cost of 260,000 francs. The scavenging plant is kept in a central depot, where materials of every description are stored and classified, for ordinary and extraordinary service, when snow and ice render additional assistance necessary.

The depots contain supplies of chloride of lime, sulphate of zinc, sulphate of iron and carbolic acid as disinfectants; and hydrochloric acid, nitro benzide (acide de mirbane) as cleansing agents.

The chloride of lime of a strength of 100 to 105 degrees is successfully employed for the disinfecting of places tainted with urine or fecal matter; also for the cleansing of gutters carrying sewage water. Sulphate of iron and sulphate of zinc are both used under the same conditions. Sulphate of iron possesses the disadvantage of rusting objects to which it is applied. Sulphate of zinc is stronger in its action, but costs a little more.

It produces no smell, nor does it leave any trace. It is much employed in summer for washing and watering the basements of the Halles Centrales, used for fish, poultry and offal. At a strength of one-eighth, and mixed with 3 per cent. of sulphate of copper, sulphate of zinc makes a good disinfecting liquor, which preserves its qualities a long time, and is of great use in private houses. Carbolic acid is not, strictly speaking, a disinfectant; nor does it act like chloride on putrid matter, but arrests and prevents fermentation, doubtless by destroying the spores. It is, therefore, always employed when it is desired to destroy the germs of putrid fermentation. It is used at a strength of about 1-40—say a gallon of the acid to forty gallons of water. At strengths of 1,100 and 1,200 it gives good results for watering once or twice a week in summer those parts of the Halles Centrale liable to infection. It is even used as low as 1-1,000 for watering streets and gutters. Hydrochloric acid is applied to urinals and slaughter houses. In places much incrusted with tartar it is used at a strength of 1-6. Lowered to 1-10 it cleans smooth walls and flags efficiently. In ordinary rinsings a strength of 1-16 suffices. It leaves a disagreeable odor behind, which is, however, quickly dissipated. Mirbanic acid (nitro benzide) is more energetic than the foregoing, but it produces a disagreeable smell of bitter almonds, and leaves a white film, which has to be washed off. It is used at the same strength as hydrochloric acid. The annual cost for plant and disinfecting materials of all descriptions is £8,800 (220,000 francs).

The engineers of the city of Paris are also charged with sweeping of the roads, an area of 12,916,800 square yards being cleaned between 3 and 6 a. m. in summer, and between 4 and 7 a. m. in winter. The carts for removing the public and private refuse work from 6 to 8 a. m. in summer and from 7 to 9 in the winter. The filling of each cart is attended to by the driver, aided by two shovelers, the latter having to provide during the rest of the day supplemental sweepings wherever required, to rinse the gutters twice a day, and to clear and disinfect urinals, etc. These matters are ordinarily finished by 4 o'clock in the afternoon, except in unfavorable weather. The engineers have at their disposal a staff of 2,200 men at from 2 francs and 50 centimes to 4 francs per day; 950 women at from 20 centimes to 25 centimes per hour; thirty children (boys) at 20 centimes per hour. In addition there are 190 mechanical sweepers, and as each machine represents the effective work of ten men, the total scavenging staff may be considered as composed of nearly 5,000 laborers.

The mechanical sweepers which, after numerous trials and much hesitation, have been introduced into Paris are the English machine, improved by M. Sohy, and the machine of M. Blot, the former being preferred. The mechanism of both is simple, works with regularity, and occupies little space; it consists of a framework upon two wheels, with a seat for the driver.

At the back is placed the sweeping apparatus, composed of an inclined circular bass broom, actuated by gearing driven from one of the wheels of the carriage.

By means of a clutch the driver can, from his seat, easily put the broom in and out of gear. The machine is employed in all weathers, and works as well on paved roads as upon macadam or asphalt. Each machine weighs rather over fourteen hundred weight, and can be drawn by one horse. It sweeps about 6,578 square yards per hour. The cost of the machine is £40, and its annual maintenance, exclusive of renewals of the brush, £8.

The cost of a new brush is about £2 16 shillings (70 francs), which will work for from 160 to 180 hours.

The Paris mud no longer possesses the manurial strength of former times, and in consequence the receipts derived by the municipality from this source have greatly diminished. It is at present disposed of by public tender to responsible contractors for terms of about four years. For its removal there are daily employed 520 carts and 980 horses. The average bulk removed per day is about 2,223 cubic yards (1,700 cubic meters).

When a fall of snow occurs attention is at first directed to clearing the foot-paths and crossings, so as to insure uninterrupted circulation of foot passengers. The town scavengers sand the roads wherever it is necessary for the carriage traffic. At the same time numerous auxiliaries are organized to remove the snow from the principal thoroughfares in the order of their relative importance.

For removing the snow the General Omnibus Company are bound by their concession to furnish fifty wagons, and carts are especially arranged for with the providers of sand and gravel at the beginning of winter, the contractors for maintaining the public roads being also bound to hold their carts at the disposition of the sectional engineers. In certain cases the half-melted snow is swept into the sewers, especially those carrying warm water.

Melting by steam has been tried, when a continuous jet was introduced into a mass of banked snow, but it melted very slowly at first, and the melting ceased after the cavity had increased to a certain size. Two descriptions of snow-plow are kept in store, one for manual the other for horse-power, but they have never been used, as the coating of snow seldom attains sufficient thickness, and it is too quickly compressed and hardened by the traffic. As a rule, the sum allowed in the budget, about £7,000, suffices for the extra labor incurred, but occasionally severe winters cause this to be greatly exceeded, as in 1875–76, when the increase amounted to £8,000.

Both hose and carts are used watering the thoroughfares, the former for the Boulevards, the avenues and a certain number of first-class streets.

The watering plants belong to the municipality. Three descriptions of carts are in use; two heavy wooden ones are now being superceded by the third, Sohy's cart, made of sheet iron. The carts contain 220, 242 and 286 gallons respectively, and will water from 2,400 to 3,500 square yards. The watering by hose is attended to by the ordinary street-cleaners, who can easily water 24,000 square yards in thirty-five minutes, deducting the time necessary to connect the apparatus with the mains. There are 322 water-carts, which, on the average, disperse 1,311,200 gallons of water over a surface of 7,139,168 square yards.

A surface of 2,783,092 square yards is watered by hose, and this system is being greatly developed on account of its convenience and cheapness.

The annual cost of watering is about £18,000.

## THE AQUEDUCTS OF ANCIENT ROME.

The well-printed and well-illustrated quarto volume of four hundred pages, whose title is subjoined, is the most important recent work on the archæology of the ancient capital of the world. It is by the engineer, Rodolfo Lanciani of Rome, and it received, as it well merited, the prize of ten thousand francs offered by his majesty the King of Italy, and adjudged to the author by the royal *Accademia dei nuovi Lincei*. It is based on the treatise of Frontinus, "De Acquæductibus Urbis Romæ," and may be described as a perpetual commentary on the text of that important work. Frontinus, who lived in the first century of our era, enumerates nine aqueducts (five of the Republican, four of the Imperial period), being all that Rome possessed up to that date. The number was considerably increased afterward, but there do not appear to have been any significant changes in the plans and methods of construction. The rules and principles laid down by Frontinus are applicable to later Roman hydraulic structures, and the work presented by Signor Lanciani* is the fullest and most satisfactory account we possess of the arrangements for furnishing water to supply the vast consumption of ancient Rome.

Of all the cities of the Greek and Roman world, Rome was most abundantly provided with water, the importance of which element, in its domestic and sanitary aspects, is now again, after centuries of neglect, beginning to be recognized as paramount among the physical conditions of urban life. We have, however, not yet quite learned to allow to water, as affecting the health, comfort, and decencies of life, the position which was accorded to it at Rome; but even to us it is inconceivable how many great cities of mediæval and even of modern ages could have existed, and been considered as elegant and refined abodes, with no artificial, or at best most inadequate, arrangements for the introduction and distribution of water among the people. Even Paris, in some sort the *arbiter elegantiarum* of modern Europe, until recently derived its supply of drinking water from the Seine, the grand recipient of the sewage of Paris, and from wells polluted by infiltration, and so late as 1836 Parent Duchâtelet published a work in which the water of the Seine was proved to be altogether inoffensive to the taste and wholesome, because the foul matter contributed to its current by the superficial and subterranean drainage of the city was not sufficient in quanity to affect sensibly the taste, the limpidity, or the salubrity of its waters!

The ancient Romans discriminated carefully be-

* "I Commentarii di Frontino intorno le Acque e gli Aque dotti; Silloge Epigrafica Aquaria. Memoria di Rodolfo Lanciani." Roma: Coi tipi del Salviucci, 1880. 400 pp. 4to.

tween the waters of different springs. What tests they employed we in general know as little as we know their rules for judging of the quality of stone and other materials employed in architecture. After the great natural division of water into fresh and salt, the most obvious distinction was between cold and hot springs. The latter of these were everywhere sought, and in all the wide domain of imperial Rome there is to be found scarcely a single spring above the ordinary temperature which is not surrounded by the ruins of old constructions obviously designed for bathing. They also considered the specific gravity of drinking water a matter of much importance. A letter of Synesius to Hypatia describes and recommends an instrument for testing the weight of water. This was simply a graduated brazen tube, closed and weighted at one end. This, of course, by the height at which the tube stood in the fluid, would answer for comparing the gravity of different waters. Chemistry had not yet taught natural philosophers that water, even in its simplest form, is not an elemental but a compound substance; they knew, however, that not only spring water, but even the purest rain water, contains, in suspension or in solution, a variety of foreign ingredients.

Much of the water introduced into Rome by the aqueducts was employed for feeding fountains—the younger Pliny speaks of a *jet d'eau*—as well as for domestic uses; but the principal object of these constructions was to supply water for bathing, for which an enormous quantity was required. Thus the aqueducts subserved the purposes of luxury as well as the necessities of life. Cast-iron being scarcely known to the Romans, the distribution of the water for the reservoirs was effected by pipes of baked clay, and where those were not applicable, of lead; and it is singular that, though skillful in casting bronze, the Roman founders were not yet able to cast lead pipe. The conduits of this material are made from cast sheets, or rather plates, of lead, wrapped around a mandrel and riveted or clamped at the opposite edges. The plates being thicker than modern rolled lead, the pipes were heaver, and accordingly the consumption of that metal was very great. From one single point of distribution of an aqueduct the Borghese family took, in the sixteenth century, not less than forty thousand pounds of lead pipe. The citadel of Alatri was supplied with water carried across a deep ravine by an inverted siphon of earthen pipes, imbedded in concrete, to a height of more than three hundred feet above the bottom of the ravine, and, of course, under a pressure of fully ten atmospheres.

Until comparatively recent times, the Romans were popularly believed to have been ignorant of the principle that water in conduits open only at the end will rise to the height of its source; but the discovery of distributing pipes at Pompeii and elsewhere, and careful study of the methods of employing them, have shown that they understood that law as well as we, and practically were much in advance of the engineers of some great cities of modern times, who, after having constructed costly aqueducts to convey, and reservoirs to contain, water from distant sources, have been unable to devise any better method of distributing it among the population than the rude expedient of employing water-bearers to carry it about the streets, in casks or skins, upon their backs. Modern science has, indeed, disclosed to us many natural laws unknown to the Romans, but it is now certain that, though they were able to utilize for mechanical purposes only the simplest applications of some elastic, and probably none of the explosive, forces, and, of course, knew nothing of the steam engine or of gunpowder, yet the methods employed by their engineers were often surprisingly like those of our own times. However erroneous the theories of ancient physicists may have been, their processes were almost always admirable, and they employed with great skill methods, the rationale of which, as expounded by themselves, was as absurd as are the principles of Chinese medicine.

The Commentaries of Frontinus are confined principally to positive statements, and bear little of the hearsay and uncritical character of the "Encyclopædia" of the elder Pliny. There is no danger, therefore, that the professional student of Frontinus will be misled by vague speculation, and we can recommend the study of Signor Lanciani's labors as likely to be eminently profitable to modern hydraulic engineers.—*The Nation.*

The Engineer of the Hyde Park (Ill.) Water Works reports that during the month of May 120,364,679 gallons of water were pumped at a cost of $68.78 per 1,000,000 gallons.

## THE DOVER TUNNEL.

The works on the tunnel, progressing under Colonel Beaumont, C. E., are now sufficiently advanced to be of real interest. The project, both in design of plan and mode of execution, is practical and ingenious. The chalk strata of England and France are geologically continuous, and the dip of the beds is the same—namely, toward the east, on both sides of the English Channel. The lowermost portion, known as the "grey chalk," is of more clayey nature than the other portions of the chalk formation, and is sufficiently impervious to water to render perforation feasible. The plan proposed is to follow by a descending tunnel the natural dip of the gray chalk toward Dover until a depth of 300 feet below the sea-bed of the Channel is attained. The Channel tunnel will then be driven horizontally right across from shore to shore. A similarly inclined tunnel on the French side, rising along the direction of the dip of the strata, will make communication again with the upper surface of the land. The gray chalk is thus entered and followed throughout along its natural position, from daylight on the one side and in its subterranean and submarine depths to daylight on the other side of the Channel. The works at Abbot's Cliff consist of a short driftway from the sea front of the "Warren" to the commencement of the trial tunnel, which is circular, seven feet in diameter, and runs parallel with the existing line of the Southeastern Railway. It has already attained a length of 300 yards. The chalk is drilled by a circular disc of iron cutters worked by a compressed air engine by means of a shaft with bevel-wheel gearing, the shaft and engine extending for a length of thirty feet. The cutting disc makes two revolutions per minute, and is fed forward a quarter of an inch at each revolution. The total advance of the whole face of the boring is half an inch per minute. The débris out of the revolving disc is received in a sort of large iron tray, which is hauled back every now and then by a chain worked by an auxiliary air engine, and the water which percolates the chalk is easily kept under by a small donkey pump. The promise of success so far seems good, but the seven-foot tunnel has not yet been driven much, if anything, below low-water tide level. Trial shafts have been driven vertically down a considerable distance both on the English and French shores, and there have been no signs of extraordinary difficulty from such sources. Nevertheless, the question of a possible fissure or deep crack in the continuity of the gray chalk itself in mid-channel, along a line passing between the "Varne" and the "Ridge," can only be actually settled when the Channel Tunnel itself solves it, and ends, once and for ever, all discussions upon the subject.

## NOTES.

### GROWTH OF TREES.

Careful observations have shown the following to be about the average growth in twelve years of several varieties of hard wood when planted in groves and cultivated: White maple becomes 1 foot in diameter and 80 feet high; ash, leaf maple or box elder, 1 foot in diameter and 20 feet high; white willow, 18 inches in diameter and 40 feet high; yellow willow, 18 inches in diameter and 35 feet high; lombardy poplar, 10 inches in diameter and 40 feet high; blue and white ash, 10 inches in diameter and 25 feet high; black walnut and butternut, 10 inches in diameter and 20 feet high.

### A NEW ENGLAND FARM SURVEY.

The following is about a fair sample of the description of the lines of a farm in New England:

"Beginning at an oak post standing near a pond of water, at the corner of Samuel Tate's survey; thence with Tate's line S. 30, W. 120 poles to two hickories to Tate's corner; thence his line S. 82, E. 140 poles to a pine; thence S. 50, W. 38 poles to two white oaks in a hollow; thence S. 4, W. 40 poles to a pine; thence S. 50, W. 36 poles to a double pine; thence N. 55, W. 60 poles to a pine; thence N. 60, W. 40 poles to a pine; thence N. 82, W. 25 poles to two pines; thence N. 10, E. 120 poles to a pine on the bank of a branch (creek); thence S. 86½, E. 112 poles to the beginning." Plot it.

### A NEW VENTILATOR.

Another Richmond in the field of ventilation is Captain J. B. Papier, ventilating engineer, of Gillet Street, Kingsland Road, with his Zenith Air or Steam Screw Ventilator. The two main features in this ventilator are, firstly, that it projects less above a roof than the most ordinary chimney-pot; and next, that, by means of funnel-shaped mouths round the top, an injection of air, caused by the natural pressure of the atmosphere, is introduced at an angle, sweeps down the hook-shaped chambers within the ventilator, being ejected in the form of a helix or screw, creating an up-draught, which clears away and sweeps before it all impure air. For factories the waste steam can be utilized, so that, when not even a zephyr or the Favonian wind is blowing, the air can be kept sweet and pure. The Holborn and Kensington new Townhalls, the Langham Hotel (for the billiard room), the Bank of England, the Holborn Viaduct Hotel, the large house of Messrs. Cassell, Petter & Galpin, La Belle Sauvage Yard, are among the places where the Zenith Ventilator has been employed; while for smoky chimneys the Peabody Buildings have purchased no less than seven hundred of this excellent and simple invention of Captain Papier. —*The Architect.*

# GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

## GAS AND WATER.

The Governor of New York has signed the bill for the removal of the reservoir situated in New York city, between Fortieth and Forty-second streets.

It is proposed to erect pumping works at the foot of Dearborn street, Chicago, to supply water for the use of elevators in the business section of the city.

From the Omaha *Herald* of the 3d, we learn that the Water Works of that city are being pushed vigorously to completion. About 400 men are employed in the construction and pipe laying at an extraordinary rate is going on. Chester B. Davis is Chief Engineer of the work.

The Asphalted Wrought-Iron Pipe Co. have booked a large list of orders during the past few weeks. They are now laying their pipe in Schenectady and Unadilla, N. Y., in Newburyport, Mass., and are preparing for several other large contracts recently awarded them in Connecticut, Massachusetts and New Hampshire.

The Rock Island water-works have for the last four years been an elephant on the city. During the winter months the water which is taken from below the city, and is supposed to be infected with the sewage of Moline, Rock Island and Davenport, causes general sickness. The city has wanted to remove the works half a mile up the river, but has not been able to supply the means. Last week the Hon. P. L. Cable, a wealthy citizen, made the City Council the munificent gift of $25,000, conditioned only that the water-works be removed during the year. Estimates of competent engineers show that the removal and enlargement of the pumping capacity can be made for $25,000, and Mr. Cable's generous gift enables the city to proceed forthwith to carry out this much-needed public improvement.

Respecting the statement recently made by Mr. Leo Daft, electrician of the New York Electric Light Association, that the cost of producing electric light by incandescence is greater than that of producing gas-light in the proportion of 1,500 to 992. Mr. Curtis, Secretary of the United States Electric Light Company, judged the figures given to be about correct. For interior lighting, he said the only practical way is by incandescence, and that is now more costly than gas, but electric lighting is in the position that lighting by gas was when it was first introduced. It is only a question of overcoming certain mechanical difficulties and perfecting the requisite apparatus, and experiments are proceeding which will ultimately accomplish the desired end. The United States Company, Mr. Curtis said, hopes to be able to furnish its lights, when it gets fairly started as a supplying agent, as cheap as gas.

The latest scheme proposed for the increase in the water supply of Chicago, is by Geo. R. Bramhall—who claims to be the "designer and builder" of the present Inlet Crib—who now submits plans and estimates for extending the present tunnel to six miles out from shore, and thence building an "aqua-port," as he calls his crib, to cost about three millions of dollars, and take three years to build. Mr. Bramhall, when asked if he had spoken to any engineers about his plans, stated, "Yes; about the first gentleman I called on to look at my work was Mr. Wright, a railroad engineer, now in the employ of the North Division Street Railway Company. He is a young man of fine talents, and a thoroughly educated engineer. He looked over my work, and seemed to think well of it. Mr. Johnson, the chief engineer of the Northwestern Railroad Company, a person for whom I have the most perfect respect, on account of his great experience in the questions we have to deal with, also looked at my plans, and expressed his gratification with them. Several other citizens, men prominent as lawyers, and as architects, and merchants, have also inspected my plans, have been exceedingly pleased with them and have assured me that it was, in their opinion, the simplest, cheapest and surest way of getting a constant water-supply for the city, and that they would do all they could to insure their adoption." This ought to settle the water question for Chicago. Let Bramhall build his Aqua-port.

Akron, O., celebrated the completion of its water-works system on the 1st in the most jubilant style, with a procession, an exhibition of the fire extinguishing facilities of the new works, and a grand banquet. Every

Akronite was happy in the prospect of having all the water he or she could drink or waste. The Akron Water-Works Company was incorporated in July, 1880, with a capital of $250,000, and composed of the following gentlemen: Frank Adams, President; E. I. Frost, Secretary and Treasurer, and F. Adams, G. W. Crouse, A. L. Conger, M. S. Frost and Charles Wilhelm, Directors. Messrs. M. S. Frost & Son are the contractors and Joseph Flannery engineer. The supply is taken from a well 27 feet deep and 50 feet diameter, which is supposed to tap a subterranean stream which runs from Lake Chautauqua to Lake Erie. This well receives an hourly inflow of 150,000 gallons, which is sufficient to supply three times the present want of Akron. The principal engineering difficulty presented by these works was how to sink this well, the material through which it had to be excavated rendering it impossible to work from the bottom up. As usual in such cases, the well was built from the top, and its sinking was successfully accomplished by the engineer in charge. From this well the water is pumped by a Worthington duplex engine of 1,000,000 gallons capacity to a reservoir 200 ft. wide, 250 ft. long, 17 ft. deep and 255 ft. above the level of one of the main streets of the city. The pumping station is designed by F. O. Weary, architect, of Akron, is composed of one engine-room, 30 × 40; boiler-room, 30 × 40, and coal room 28 × 30, built of brick and artificial stone, and finished inside in oak. The stack is 95 feet high, 11 feet at base, and 6 feet at top, and is furnished with a smoke consuming apparatus, invented by Engineer Flannery. The pipe was furnished by the Lake Shore Foundry of Cleveland; the valves by the Chapman Manufacturing Co.; the hydrants by R. D. Wood & Co.; the boilers by J. C. McNeil, and the castings and special work by Taplin, Rice & Co., of Akron. Messrs. H. R. Worthington & Co. are putting in a larger engine to supplement the one at present in use

It is not certain that the city council will do anything in regard to water-works to-night at its meeting, nor is it well settled what it can do; but the council will probably be put in possession of a good deal of information that it did not possess at its last meeting. It is now known that the city can construct ample water-works for its population for the next half century with eight miles of mains and eighty hydrants for eighty thousand dollars, or with ten miles of mains and one hundred hydrants for one hundred thousand dollars. It is also known that the city can without a cent of cost, other than printing the bonds, negotiate at par and at 4 per cent., eighty or one hundred thousand dollars for fifteen or twenty years. It is known that the construction of such a system of water-works would save the people of the city not less than five thousand dollars annually in insurance premiums now paid to Eastern insurance companies, and at least one-half of the present cost of maintaining its fire department. These things are not surmises, but are known facts. Besides it is practically settled that within two years after the construction of such a system of water-works, the water rents would much more than pay running expenses, and not unlikely running expenses and the interest on the bonds issued, so that if the city would pay into a sinking fund six thousand dollars a year, for the use of eighty or one hundred fire hydrants, the sinking fund before the end of twenty years would pay off the whole of the bonded debt. All these things are now so well known, by those who have carefully studied the subject, that there is not a question about the wisdom of the construction of a system of water-works by the city at the earliest period within which it can be done and carefully done. The questions of how to proceed with the work and what particular machinery to put in are yet open for consideration; as is also that of the water supply. The Holly Manufacturing Company would be only too willing to construct the works on a franchise and on far better terms than were offered by the Billings proposition; but only on condition that water be taken from artesian wells. A decided objection would be made to taking water from the lake on the ground that the uses to which water would be put in this city are for culinary purposes, drinking, fire purposes, sprinkling streets, flushing gutters and sewers, for all of which uses mineral water is as good as lake water, and for most of which it is infinitely better. It is claimed that there are not over a dozen steam-engines in the city, most of which are now supplied in whole or in part with cistern water, and would not change that for any other so long as it holds out. The same is true in regard to water for washing purposes—rain-water will be used in preference to any other where it can be had, and that is a large portion of the time. This argument is decidedly in favor of artesian well water for water-works.

But the matter of water supply and the kind of machinery are still subjects for consideration. Of the wisdom of the early construction of water-works, from a pecuniary point of view, as well as that of health, convenience and comfort, there is not room for discussion any longer among those who have carefully investigated the matter.—*Madison Democrat.*

## STREETS, DRAINAGE, ETC.

WASHINGTON, June 7.—The Mutual Union Telegraph Company are extending their wires through this city by using the common sewers. This is an important experiment, and one which all large cities will watch with great interest, for the reason that if successful the unsightly poles now used to disfigure the streets will be abolished. A large force is now engaged in running the wires of this company through the city sewers. The numerous wires, which are intended to make all the connections inside the city, are twisted in cable form and covered with a non-conductor and water-proof coating. Outside the city limits these wires will emerge from the sewers and join those placed upon poles. The cable made of the twisted wires is attached firmly to the arched roof or top of the sewer, and thus raised above all interference from water, except in case of floods. The cables are laid by men who are enveloped in rubber clothing and provided with safety lanterns, provision being made for conducting fresh air to the workmen by means of india-rubber tubes attached to their rubber suits. The wires are passed down through the man-hole of the sewers. The managers of the company who devised this plan already claim that it is a complete success.

The town of Lake View, Ill., has petitioned for a sewer connection with the Chicago Fullerton avenue conduit. There is authority for making such an arrangement under the law passed by the Legislature in 1877. It is a sanitary measure in which both towns are interested. Lake View has no established sewerage system. It has several underground sewers which emptied into the lake. It is proposed to inaugurate a system of sewerage by the town, emptying in part into the conduit, and in part into the North Branch or the lake. If the sewerage flowed into the river the city would have to pump it out any how. The town of Lake View has the authority to discharge its sewerage into the river, if it so willed, to the annoyance of Chicago. The Common Council Committee has referred the whole matter to the Corporation Counsel, Commissioner of Public Works, and the City Engineer, to confer with the officials of the town of Lake View, they to prepare such papers as might be deemed necessary for future consideration of the committee.

Commander Gorringe has felt it necessary to inform the Mayor (of N. Y.) that he would not accept the office of Commissioner of Street Cleaning if nominated to it, because he has always held that the undivided responsibility and authority of the Commissioner were necessary to the proper discharge of the duties of office. He finds, however, that the bill just passed divides this responsibility and authority between five different departments of the city government, giving the least share of all to the Street Cleaning Department. Commander Gorringe is probably under the impression that it was by some sort of oversight or miscalculation that this result was reached; whereas it is exactly what the authors of the bill intended. They meant that there should be a fair divide of the patronage of the place among as many influential persons as possible. Moreover, the Commander evidently thinks the cleaning of the streets ought to have been the sole object of the bill; but in this his judgment is obscured by his naval education. On board ship, it is true, the care and navigation of the vessel are, in time of peace, the one object of the officers and crew, but that is because there is on board ship an office for everybody. On shore it is very different. There are not nearly enough offices to go round, and they have to be distributed so as to keep the discontent down to the lowest possible point, even if the streets are a little dirty. If there were not enough offices on board ship for the ship's company, the apple-pie order for which men-of-war are famed could not be kept up, as the officers would have to spend most of their time talking to the office-seekers, keeping them in good humor, and promising to get them put into vacancies, and not to look when they were stealing the stores or sleeping on watch.—*The Nation.*

## BRIDGES.

A railroad bridge over the Ohio at Wheeling, W. Va., is being discussed.

The N. Y. Legislature has passed the bill authorizing the town of Warwarsing, N. Y., to borrow money to build a bridge.

The contract for a new bridge over the Hudson River at Albany, N. Y., has been awarded to Clark, Reeves & Co., Phœnixville, Pa. The bridge will have a draw-span 400 ft. long, and two fixed spans of 353 ft. each, and will be a double-decked bridge, with two railroad tracks on the upper deck and a roadway for vehicles on the lower deck. There will also be two sidewalks outside the trusses.

The Phœnix Iron Company have signed contracts for the next four months for bridge work which will aggregate between eight and ten thousand tons of iron. The company have bridges on hand for the Delaware, Lackawanna & Western, the Great Western Railway of Canada, Morgan's lines and Huntington's railways in Texas, the Mexican Railway Construction Company, the Philadelphia, Wilmington & Baltimore Railroad Company, and the Old Colony road.

DIMENSIONS OF THE BRIDGE AT BLACKWELL'S ISLAND.

| | Feet. |
|---|---|
| Span from Ravenswood to Blackwell's Island | 618 |
| Viaduct across Blackwell's Island | 700 |
| Span from Blackwell's Island to New York | 734 |
| Length of bridge from Long Island shore to New York shore | 2,052 |
| Approach on Long Island side | 4,700 |
| Approach on New York side | 3,000 |
| | 7,700 |
| Entire length of bridge and approaches | 9,752 |
| Height of masonry for piers above high water | 10 |
| Height of iron towers at piers | 260 |
| Height of pillars of Island viaduct | 150 |
| Height of bridge floor above mean water mark | 156 |
| Two railway tracks, each 14 feet wide | 28 |
| Two carriage ways, each 9 feet wide | 18 |
| Two sidewalks, each 5 feet wide | 10 |
| Three cables, each 6 feet wide | 18 |
| Entire width of bridge | 74 |

Engineers are T. C. Clarke and A. Bonzano; contractors, Clark, Reeves & Co., of Phœnixville. Proposed cost, five millions of dollars.

The Albany & Greenbush Bridge Company has at last gotten into strong hands, and will be pushed day and night until its completion, under contract for December 1 of this year. Mr. Alfred P. Boller is Chief Engineer of the work; Mr. C. L. Cooke, Prin. Asst. Engineer, and Clarke, Reeves & Co., Phœnixville Bridge Works, Contractors for the whole work, foundations, masonry and superstructure. The bridge proper consists of two 250 ft. spans, and a draw span 400 ft. long, and will be built as a double decker—a double track railway above, and highway with sidewalks either side below. The enormous loads to be carried and great length of the draw, brings the work pretty near up to the limit of wrought iron construction. The above contract amounts to half a million of dollars, exclusive of the approaches, which are not yet awarded.

## RAILROADS.

An article in the Boston *Herald* informs those unfortunates who are troubled with "car sickness" in traveling, that a sheet of writing paper worn next to the person, directly over the chest, is a sure preventive of the trouble, nine cases out of ten.

Gen. Frisbie has obtained in Mexico, a railway concession which is deemed to be the most valuable yet granted. It connects with the Southern Pacific on the Rio Grande and runs to Mexico City, with branches to the Gulf and the Pacific.

The building of the underground railroad from the South Side to Lake View, with a surface road beyond, is now assured. The presidency of the company has been taken by Mr. Richardson, the President of the London Underground Road. His connection with the enterprise at once stamps it as practicable, and certain to be put through. All the money needed has been raised in London, and the only point that is in doubt is whether the people of Chicago will have any opportunity to put any of their own capital into what is certain to be an immensely profitable enterprise.—*Chicago Tribune.*

The first annual meeting of the New York Railroad Tunnel Company was held on the 7th inst. at No. 24 Pine street. The company was organized under the Hayes Tunnel bill on June 26 last, and proposes to build a tunnel from the New York terminus of the Hudson River Tunnel at Washington square under University place to Union square; thence up under Fourth avenue till it shall connect with the cutting on Fourth avenue beyond the Grand Central Depot. It is proposed to have a double-track line and to use the tunnel for the running of freight cars from the West to the roads centering at the Grand Central Depot. The officers of the company are: President, H. Walter Webb; Vice-President, H. E. Stetson; Secretary, E. M. Brown; Treasurer, C. D. Sidell; Directors, C. D. Ingersoll, H. W. Webb, C. D. Sidell, Henry L. Sprague, E. M. Brown, B. Aymar Sands, J. D. Mowre, S. J. Gorman, H. E. Stetson, Ogden P. Pell, Henry F. Pultze, H. R. McElligott, H. C. Hepburn.

HARRISBURG, June 7.—A charter was granted at the State Department to-day to the Fulton & Washington Railroad, with its office located at Philadelphia. The capital is $1,218,000, and among the incorporators are: Edwin L. McConaughy, Robert M. Janney and Charles D. Barney. The new road runs from a point on the Ohio State line in Washington County to a point on the Maryland State line in Fulton County, a distance of 203 miles, with a gauge not to exceed three feet. A charter was also granted to the Southern Tier Railroad Company, the incorporators being the same as in the above road, with office at Philadelphia. The capital is $1,248,000, and the new road runs from Waynesboro, Franklin County, to West Elizabeth, Allegheny County, a distance of 208 miles. This new road is also narrow gauge.

## RIVERS AND HARBORS.

Captain Rankin, of the Bohemian, and Captain Demers, of the La Prairie, along with a couple of government engineers, have made a survey of the river channel from the Victoria Bridge to St. Helen's Island, with a view of straightening and widening it. The money for this work was voted a couple of years ago by the government.

## CONTRACTING, MISCELLANEOUS, ETC.

The total cost of the new court house and jail at Springfield, O., is $120,204.

Lima, Ohio, is having a $100,000 Opera-house built. B. C. Faurote is the contractor.

Chief Engineer Morris, of the Cincinnati, Indianapolis, St. Louis & Chicago road, will this week award contracts for the building of an iron bridge, 468 feet in length, over the Kankakee River at Aroma, and another bridge, 170 feet in length, over the Iroquois River.

According to Section 2,186 Revised Statutes and following, a Board of Improvements in a city of Akron's grade consists of the Mayor, the City Civil Engineer, the Street Commissioner, the Chairman of the Council Committee on Streets, and one freehold elector of the corporation, to be appointed by the Mayor, with the consent of the Council. The work of the board is to "supervise the cleaning, repairing and improving streets, alleys, avenues, lanes, public wharves and landings, market houses and spaces, bridges, sewers, drains, ditches, culverts, ship places as may be deemed necessary, within the corporation, under the control of the Council of the city." It may adopt rules; appoint a clerk; may employ superintendents to supervise public works or may supervise them itself, and is to receive and act upon all petitions. No improvements can be made by the Council without the recommendation of the Board. The members must serve without compensation.